AIAA DPW4

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Baseline Unstructured Grids

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Baseline unstructured grids

- **VGrid/PostGrid 4.2**
  - **Volume and surface* sources used**
- **Cessna's contribution**
  - **Patching, initial sourcing and grid generation**
- **NASA's contribution**
  - **Smoothed all grids**
  - **Generated second set of grids with slower viscous growth rates**
  - **Generated cell based versions**
  - **Generated extra-fine grids**
- **Coarse, Medium, Fine and Extra-fine** grids generated**

***Surface source capability not released to public**
****Shahyar only able to complete NASA extra-fine grid**

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Grid differences

Cessna Grid

- **Faster BL growth rate: R1=0.15, R2=0.06**
- **Volume sources at wing root**
- **Discrete linear sources on fuselage**
- **Med. grid "ifact"=1.0**
- **Better surface resolution**

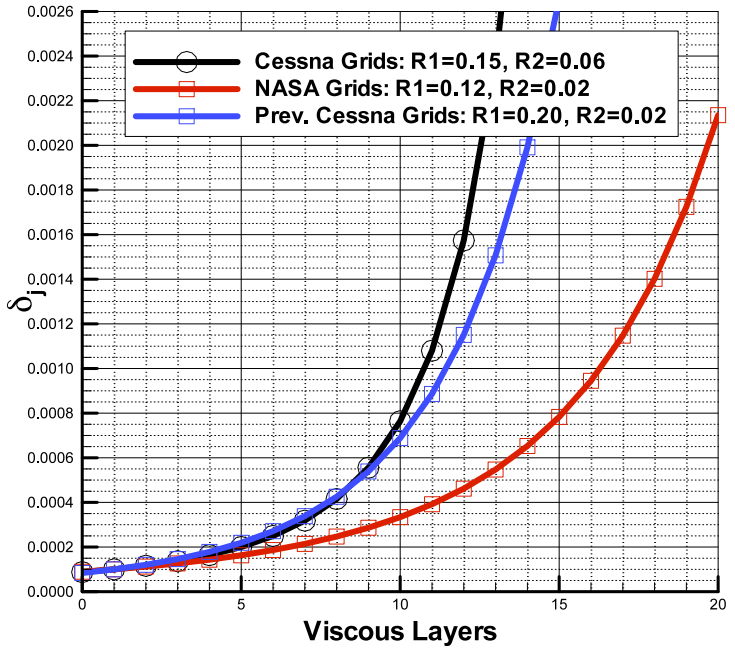
NASA Grid

- **Slower BL growth rate: R1=0.12, R2=0.02**
- **Volume sources at wing/ tail TE**
- **Surface sources on fuselage**
- **Med. grid "ifact"=1.2175**
- **Better boundary layer resolution**

Effect of growth rate parameters

- $\delta_j=\delta_1*(1+R1*(1+R2)^{j-1})^{j-1}$

- **Cessna grids use R1=0.15, R2=0.06**
- **NASA grids use R1=0.12, R2=0.02**
- **Reduced growth rate leads to increased number of points in viscous portion of grid**
- **"ifact" used to bring overall grid size to match that of Cessna grids**



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Grid statistics (node based grids)

Grid	Cessna Nodes (millions)	NASA Nodes (millions)	Cessna Faces (millions)	NASA Faces (millions)	Cessna Visc. Cells (millions)	NASA Visc. Cells (millions)
Coarse	3.55	3.66 (103%)	0.309	0.228 (74%)	15.54	18.96 (122%)
Medium Tail off	8.48	8.21 (97%)	0.554	0.418 (76%)	27.99	34.99 (125%)
Medium	9.93	10.23 (103%)	0.745	0.566 (76%)	38.09	48.60 (128%)
Fine	35.21	35.97 (102%)	2.104	1.665 (79%)	108.19	145.07 (134%)
Extra fine	NA	105.63	NA	4.045	NA	356.47

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Surface resolution details

Grid	Cessna "ifact"	NASA "ifact"	Cessna Fuselage Faces	NASA Fuselage Faces	Cessna Wing/Tail Faces	NASA Wing/Tail Faces
Coarse	1.597	2.0142	39,096	17,832 (46%)	161,472/ 80,563	119,564/ 59,352 (74%)
Medium	1.0	1.2175	95,966	45,912 (48%)	399,437/ 197,983	311,198/ 152,689 (78%)
Fine	0.58	0.6845	280,971	138,885 (49%)	1,145,045/ 562,328	954,497/ 454,876 (82%)

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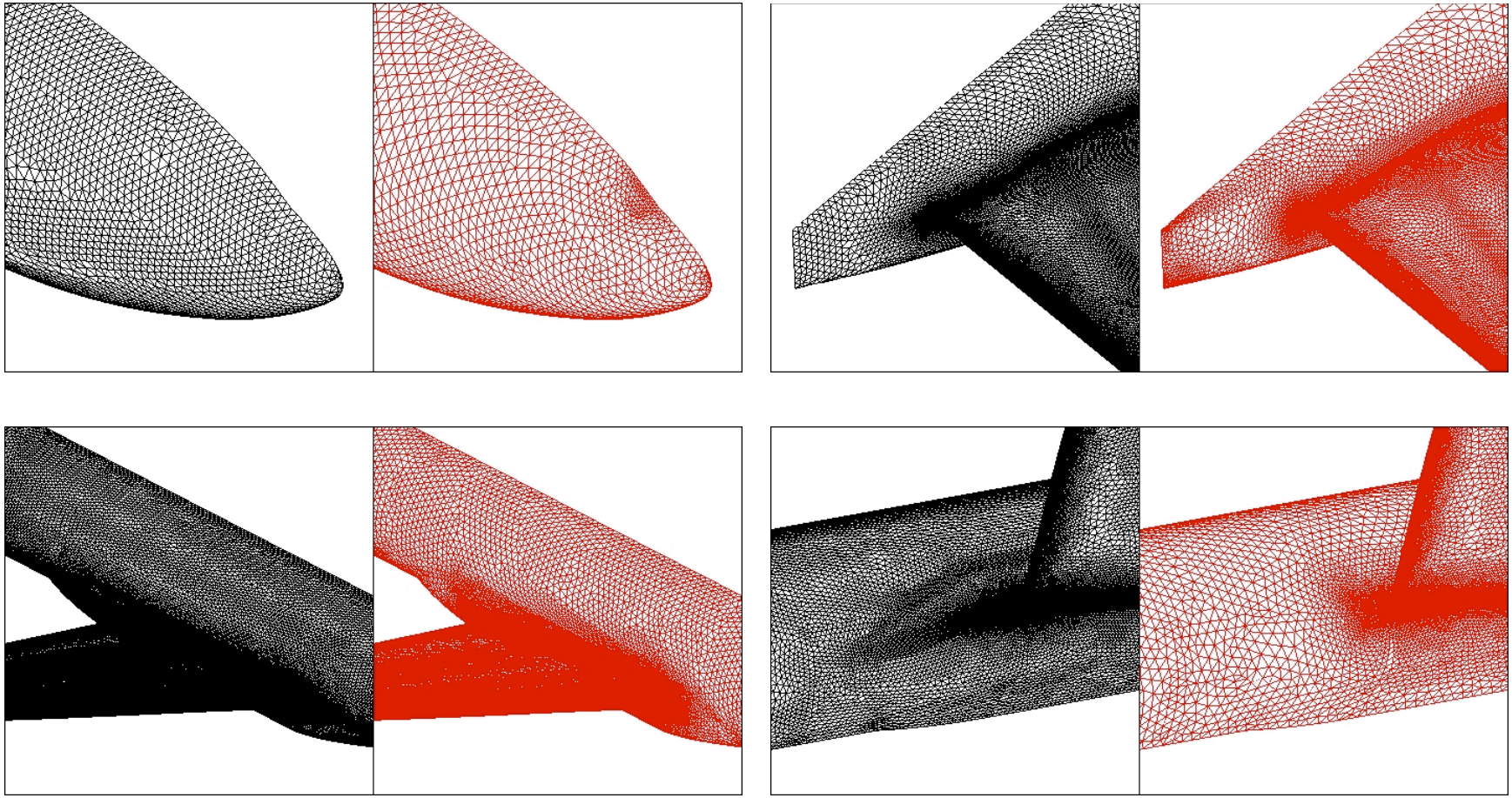
Cessna and NASA grids



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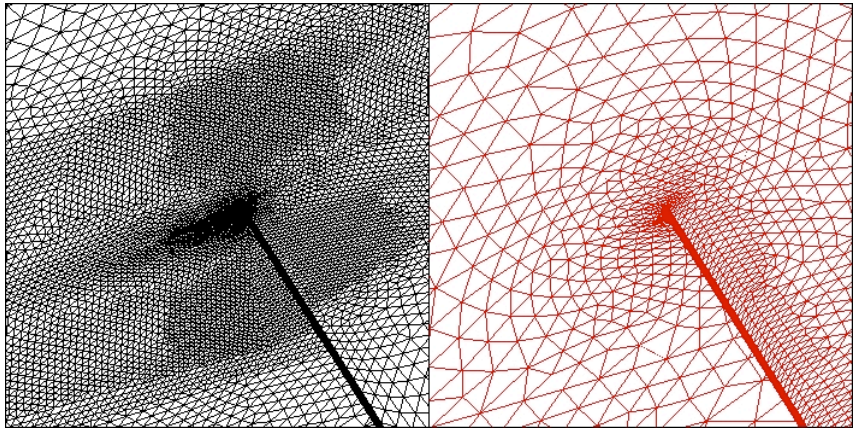
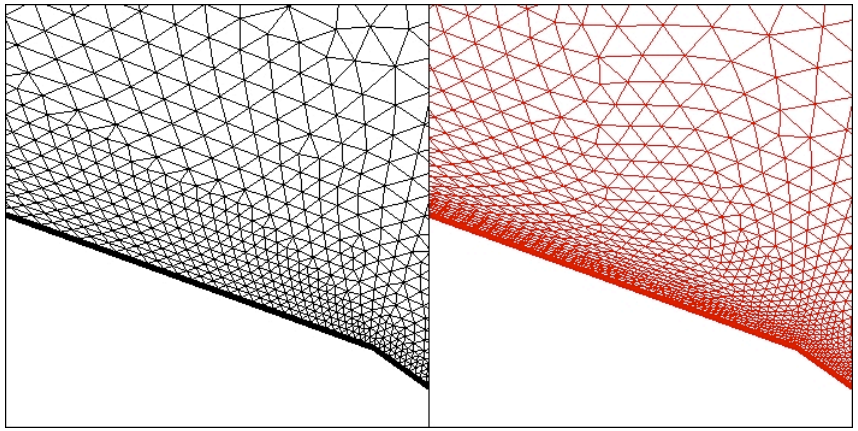
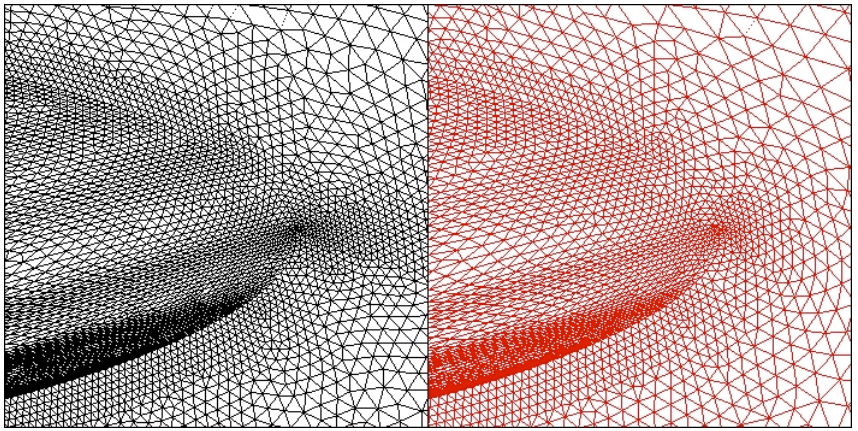
Cessna and NASA grids







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Baseline unstructured grids

- **NASA grids have slower viscous growth rate and more cells in the viscous layers**
- **Cessna grids have increased surface density, especially on the fuselage, wing, and tail**
- **Due to sourcing and "ifact" differences the grids represent two families of grids**
- **Closing fine grids could be difficult for PostGrid**
- **Extra-fine grid generation was very challenging for VGrid/PostGrid**

Backup slides

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Number of surface faces for coarse grid

Component	NASA ifact=2.0142	Cessna ifact=1.5970	% decrease due to ifact
Total	215,694	300,504	28
Outer	304	538	37
Symmetry	18,606	18,835	1
Fuselage	17,832	39,096	54
Wing	119,564	161,472	26
Tail	59,352	80,563	26

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Number of surface faces for medium grid

Component	NASA ifact=1.2175	Cessna ifact = 1.0	% decrease due to ifact
Total	545710	732319	25
Outer	858	1284	33
Symmetry	35053	37649	7
Fuselage	45912	95966	52
Wing	311198	399437	22
Tail	152689	197983	23

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Number of surface faces for fine grid

Component	NASA ifact=0.6845	Cessna ifact=0.58	% decrease due to ifact
Total	1629422	2083140	22
Outer	2670	3744	29
Symmetry	78494	91052	14
Fuselage	138885	280971	51
Wing	954497	1145045	17
Tail	454876	562328	19